This agrees very well with the reported 500 feet measurement. In that MobileVision paper, it was concluded that there is a real problem to the local area system. Amtech have proposed reducing their transmitted level to 200 or 50 mW in order to reduce interference, and the analysis showed that interference would be caused by a mobile one mile away.

Using the analysis from the MobileVision paper, (Annex3 Reply Comments) it is calculated that the Amtech system would interfere with the Pinpoint mobile at distances of 247 feet to a quarter of a mile. The reported interference was at 195 feet. The conclusions are clear, in the vicinity of a local area system a Pinpoint mobile loses its command channel, even when the base station is only 2 miles away. Only the Pinpoint system suffers from this interference because the other wide band systems use narrow band forward links. Hatfield Associates concluded that this interference is "not harmful to its (Pinpoint's) overall operation". If the local area system was at 30 feet and the power is 30 W then there will be a significant dead-zone around every Amtech station to the Pinpoint system. A dead-zone that does not exist for the other systems.

1. Analysis of Pinpoint ARRAY network testing.

1.1. Experimental Network

The base stations lay in a roughly circular pattern about 3 miles across. The test route runs across two bridges and along the sides of the Potomac river, mainly through parks. It is claimed that the test route includes "urban canyons" or that the conditions are "something approaching worst-case". In fact, the conditions were essentially 'open water' between the base stations and the mobile and these test conditions are normally considered benign.

The test route is never more than 2 miles from four base stations and at its farthest point is 2.5 miles from the fifth.

In Annex 1 of the MobileVision Reply Comments, July 1993, a formula was derived for the comparison of range between two systems.

To compare two systems, 1 and 2,: $$\frac{D_1}{D_2} = \sqrt[3.5]{\frac{PG_1.Fc_2}{PG_2.Fc_1}}$$

where PG is the processing gain and Fc is the chipping rate.

For example, for the MobileVision system (1), PG = L = 255 and Fc = 2Mchips/s
and Pinpoint system (2) PG = 127/4 (15dB)
and Fc = 11.536Mchips/sec[3]

then, $$\frac{D_1}{D_2} = 2.99$$

Thus the MobileVision system has theoretically nearly three times the range of the Pinpoint system, or, stated differently, a single MobileVision cluster covers 9 times the area of a Pinpoint cluster. A map of the Washington area is given on the next page that shows the positions of the Pinpoint sites together with those of a realistic operating system[4]. The inference is clear; the Pinpoint system has limited range and they will need to install over 4 times as many stations as MobileVision, Teletrac or SBMS in order to cover a specific area.

---

[3]Pinpoint application for Experimental License, August 1993, states that the code length is 127 and that 4 data bits are encoded into each sequence. The chipping rate is also given as 11.536MHz.

[4]Standard MobileVision cell is 8 miles radius. The positions on the map are consistent with distances between sites referred to in the Pinpoint's Fort Worth licence application.


D.C.
Washington
Hillcrest
Heights
Rose
Hill

1.2. Position Determination

The results, as presented in the Review, are not easy to analyze. For example, Figure 5 shows four different symbols plotted on the route. It is not possible to group them or to see what the system results were. The symbols refer to the different 'pairs' of stations, but at least three stations (or four) are needed to give an actual location. Also the results appear to be the result of "25 location computations". Are they therefore an average? As presented, the location accuracy of the system is not shown. If the result was "about 200 feet", as claimed, then in these conditions that is not a good result[5].

1.3. Signal Strength

In the Hatfield Review, Figure 6 shows the signal strength recorded against distance.

It is stated that the Transmodem unit has a sensitivity of -85dBm. The effective noise figure can be calculated as follows:

The thermal noise floor is -174 dBm/Hz and thus, in 16 MHz bandwidth,
noise floor is -102dBm.
For 15dB processing gain and 10 dB output signal to noise ratio,
the jamming margin is 5 dB.
Thus, sensitivity is -107dB plus the noise figure (NF).

Therefore NF = -85 +107 = 22 dB
22dB is a high noise figure, and not compatible with the statement "competently designed".

Figure 6 shows 50 dB variations of signal level at similar distances attributed to the wide variety of propagation conditions. The expected signal strength can be calculated as follows:

Assuming:
distance = 2 miles, base station antenna height 150 ft and the van antenna height 6 ft,

using 'Egli',	propagation loss	= 127dB.
using 'Free-space'	propagation loss	= 102 dB.
using 'Hata'	propagation loss	= 110 dB open conditions
		= 130 dB suburban conditions.

Thus the median propagation loss can be expected to vary from 100 to 130 dB at 2 miles.

Assuming 500W ERP and a 2 dBi mobile antenna gain,
the median received signal level is -41dBm to -71dBm. at 2 miles

[5] In a single cluster area, that covers real suburban conditions, and that is more than 70 times larger, the MobileVision system accuracy is better.

and -45 dBm to -78 dBm at 3 miles.

Figure 6 of the Review, shows results of about -50 to -82dB, at 2 miles, indicating obstruction losses in the order of 10 dB. At 3 miles, Figure 6 shows signal levels of -45 to -95 dBm. The results therefore agree well with calculations.

Thus, with a 500W spread spectrum signal and a sensitivity of -85 dBm, the propagation distance is 3 miles for the Pinpoint system. This result agrees with the result of the MobileVision analysis[6] that the Pinpoint system has a limited range in comparison with the other LMS systems[7]. Indeed it is worse than originally predicted because of the poor mobile receiver noise figure.

The results of the Pinpoint signal strength test indicate the system has a limited range when compared to the use of a narrow band forward link. The use of a spread spectrum forward link is shown to be inefficient and, in addition to the poor range, it will be shown to be susceptible to interference.

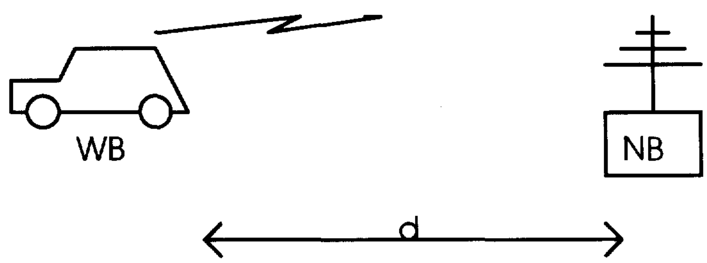
1.4. Compatibility testing (with Amtech local area system)

Annex 3 of the MobileVision Reply Comments, July 1993, analyzed the effects of interference between local area and wide band systems. It is disappointing that Hatfield Associates did not carry out any analysis into the results of the Pinpoint tests.

Using the same calculation procedure as given in Annex 3 of the MobileVision Reply Comments, and based on the information provided in the Hatfield Review, the following analysis shows that the interference was close to that predicted. The conclusions, however, are opposite to those drawn by Hatfield Associates, namely that local area systems are susceptible to significant interference and the Pinpoint system suffers from a unique dead-zone that is not present in the other AVM systems.

1.4.1. - Wide band mobile transmission blocking Local area fixed reception.

As per Annex 3, section 2.1.(MobileVision Reply Comments, July 1993)



[6]As given in Annex 1, MobileVision Reply Comments, July 1993.

[7]In the MobileVision test system in southern Florida, a 200W narrow band command channel is reliably received by mobiles in excess of 20 miles from the station

In this case the two antennas are close to the ground therefore plane earth propagation is assumed. The plane earth propagation loss is given by the formula[8]:

$$Lp = 147.5 - 20 \log h1\ h2 + 40 \log d$$ where h1, h2 are antenna height in feet and d is the distance in miles.

Assuming h1 = 7 and h2 = 6 (7 ft height of Amtech station, 6 ft mobile antenna height)

$$Lp = 115.4 + 40 \log d$$

Assuming that the mobile transmits at 40W, the received level at the Local area receiver will be:

$$Pr' = 46 - 115.4 - 40 \log d \quad \text{dBm}$$

Now the local area receiver bandwidth is believed to be about 1MHz, so, assuming the mobile spread spectrum is 16 MHz wide, the effective received signal will be 12 dB less.

Therefore $\quad Pr = Pr' - 12 = -81.4 - 40 \log d \quad$ dBm.

Assuming the received level is -28dBm [9]and a signal to noise ratio of 10 dB is required, then the interfering level will need to be -38dBm in order to desensitize the reception.

Thus,

$$-81.4 - 40 \log d = -38$$
$$40 \log d = -43.4$$
$$d = .08 \text{ miles} \quad (434 \text{ feet})$$

The above calculations have assumed that the receiving antenna does not have any gain in the direction of the interfering signal, however, this is not necessarily true and any antenna gain would amplify the interference. For example, if the antenna was pointing at the mobile, then the interfering signal is 10dB higher

$$d = .146 \text{ miles } (772 \text{ feet})$$

Thus the calculated distance for interference is 434 to 772 feet.

The results of the Pinpoint test were that interference was experienced for 500 feet out to 0.5 miles. The 500 feet figure agrees very well with the above calculation. The 0.5 mile figure is probably caused by the use of the 4.5 dB antenna on the Amtech system plus losses in the reflected signal, which have not been accounted for in the calculation. It should be noted that the Amtech antenna height was only 7 feet in the test, yet it is

---

[8]K.Bullington, "Radio propagation for vehicular communications", IEEE Trans. Veh. Technol., Vol. VT-26, no. 4. pp 295-308, Nov. 1977.

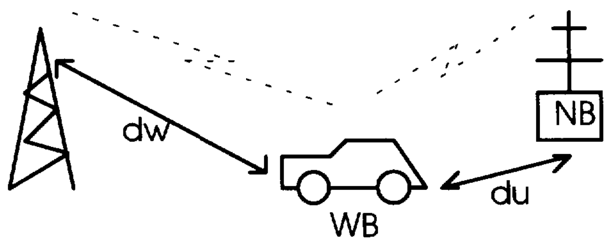
[9]Using the free space propagation formula, the attenuation for a distance of 10 feet is in the order of 40dB. Therefore a total of 80dB loss will occur for the there and back path between the transmitter and the receiver. For 42dBm transmission(32dBm plus 10dB antenna), therefore, the received level will be -38dB. Assuming a receive antenna gain of about 10dB, the receive level will be -28dBm. In practice it will be less due to losses in the passive reflector.

proposed to allow antennas as high as 30 feet. This will worsen the situation by increasing the interference by 12 dB and doubling the distances, calculated above, to .16 and .28 miles respectively.

The calculations agree well with the measurments, and thus, the conclusions drawn in MobileVision's original paper (Annex 3) are valid. It was concluded that there is a real problem for the local area system. Amtech has proposed to restrict its transmitted level to 200 or 50 mW in order to reduce interference, and, under these conditions, the analysis showed that interference would be caused by a mobile one mile away.

As a result of the analysis and tests, it is clear that local area systems are susceptible to significant interference from the wide band mobiles. This conclusion is contrary to that of the Hatfield Review.

1.4.2 - Local area fixed transmission blocking Wide band mobile reception.



Assuming that the wide band fixed transmitter power is 500W, and the antenna height 300 feet (USA Today building)

Using 'Egli', at the mobile,

$$Pw = 57 - 108 - 40 \log dw$$
$$Pw = -52 - 40 \log dw$$

Assuming 32dBm from the local area fixed transmitter (assuming no antenna gain), and plane earth propagation:

$$Pu = 32 - 115 - 40 \log du$$
$$Pu = -83 - 40 \log du$$

The mobile has a processing gain of 15dB and a 10dB S/N requirement is assumed. The jamming margin is therefore 5 dB, thus:

$$Pu = Pw + 5$$
$$40 \log dw/du = 36$$
$$dw/du = 7.9$$

Assuming that the mobile is 2 miles from the base station, then dw = 2 and du = 0.25 mile i.e. interference will occur when the mobile is within a quarter mile (1320 feet) of the local area system

This result is worse that the reported 195 feet. Note, however, that the location of the Amtech site presented an almost perfect line-of-sight to the base station, and therefore the receive of the desired signal level at the mobile could have been higher. Also the directivity of the Amtech antenna would be in the order of 10 dB. Using these assumptions, the calculations can be modified to:

$$Pw = -38.8 - 20 \log dw$$
$$Pu = -93 - 40 \log du$$
$$20 \log (dw/du^2) = 59.2$$
$$(dw/du^2) = 912$$

For dw = 2 miles du = 247 feet.

This agrees very well with the result reported in the Hatfield Review.
If more exact readings and better details of the local area system were given, then it would be possible to check the analysis better. It is clear, however, that there is a reasonable confidence in the analysis and the following conclusions can be drawn:

- in the vicinity of a local area system a Pinpoint mobile loses its command channel, even when the base station is only 2 miles away.
- only the Pinpoint system suffers from this interference because the other wide band systems use narrow band forward links.

Hatfield Associates conclude that this interference is "not harmful to its (Pinpoint's)overall operation". If the local area system was at 30 feet and the power 30 W, then there will be a significant dead-zone to the Pinpoint system around every Amtech station . A dead-zone that does not exist for the other systems.

JOINT DECLARATION OF ANTHONY J. SPADAFORA AND GRAHAM K. SMITH

We, Anthony J. Spadafora and Graham K. Smith, are Vice President - Technology and Director - Systems Research, respectively, for METS, Inc., the general partner of MobileVision, L.P. We have prepared the foregoing technical documents accompanying the Further Comments of MobileVision, L.P. in response to the ex parte submissions filed by Pactel Teletrac and Southwestern Bell Mobile Systems in PR Docket No. 93-61, Amendment of Part 90 of the Commissions' Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems. We declare under penalty of perjury that the foregoing technical documents, to the best of our knowledge, are true and correct.

Anthony J. Spadafora

Graham K. Smith

Date: March 14, 1994

CERTIFICATE OF SERVICE

I, Lila A. Mitkiewicz, hereby certify that copies of the foregoing **Further Comments of MobileVision, L.P.** were forwarded this 15th day of March, 1994 by U.S. first-class mail to the following individuals:

* Ralph A. Haller, Chief
Private Radio Bureau
Federal Communications Commission
2025 M Street, N.W., Room 5002
Washington, D.C. 20554

* Beverly G. Baker, Deputy Chief
Private Radio Bureau
Federal Communications Commission
2025 M Street, N.W., Room 5002
Washington, D.C. 20554

* F. Ronald Netro
Engineering Assistant to the Chief
Private Radio Bureau
Federal Communications Commission
2025 M Street, N.W., Room 5002
Washington, D.C. 20554

* Kent Y. Nakamura
Legal Counsel to the Chief
Private Radio Bureau
Federal Communications Commission
2025 M Street, N.W., Room 5002
Washington, D.C. 20554

* Rosalind K. Allen, Chief
Rules Branch
Private Radio Bureau
Federal Communications Commission
2025 M Street, N.W., Room 5202
Washington, D.C. 20554

* Martin D. Liebman
Private Radio Bureau
Federal Communications Commission
2025 M Street, N.W., Room 5126
Washington, D.C. 20554

* Bruce A. Franca, Deputy Chief Engineer
Office of Engineering and Technology
Federal Communications Commission
2025 M Street, N.W., Room 7002-A
Washington, D.C. 20554

* Richard B. Engelman, Chief
Technical Standards Branch
Office of Engineering and Technology
Federal Communications Commission
2025 M Street, N.W., Room 7122-B
Washington, D.C. 20554

* Karen Brinkman, Esq.
Special Assistant
Office of the Chairman
Federal Communications Commission
1919 M Street, N.W., Room 814
Washington, D.C. 20554

* Brian F. Fontes, Esq.
Chief of Staff
Office of Commissioner Quello
Federal Communications Commission
1919 M Street, N.W., Room 802
Washington, D.C. 20554

* Byron F. Marchant, Esq.
Legal Adviser
Office of Commisioner Barrett
Federal Communications Commission
1919 M Street, N.W., Room 844
Washington, D.C. 20554

* Robert Hoggarth, Esq.
Gurman, Kurtis, Blask
& Freedman Chartered
1400 Sixteenth Street, N.W.
Suite 500
Washington, D.C. 20036

* David E. Hilliard, Esq.
Wiley, Rein & Fielding
1776 K Street, N.W.
Washington, D.C. 20006

* Kathleen Abernathy, Esq.
Deborah Moon, Esq.
Pacific Telesis
1275 Pennsylvania Avenue, N.W.

Suite 400
Washington, D.C.

* Henry M. Rivera, Esq.
Larry S. Solomon, Esq.
Ginsburg, Feldman & Bress
1250 Connecticut Avenue, N.W.
Washington, D.C. 20036

Gary M. Epstein
Raymond B. Grochowski
Latham & Watkins
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

Robert B. Kelly
Kelly, Hunter, Mow & Povich, P.C.
1133 Connecticut Avenue, N.W.
Washington, D.C. 20036

George Y. Wheeler
Koteen & Naftalin
1150 Connecticut Avenue, N.W.
Suite 1000
Washington, D.C. 20036

L. Mitkiewicz
Lila A. Mitkiewicz

* Delivered by Hand